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Application of agricultural waste biochar for canteen wastewater treatment in Chulalongkorn University

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Introduction

The wastewater from the canteen is routinely treated by precipitation followed by bioaugmentation. At times, the oil and grease, TSS, COD and BOD in effluent is found in high concentrations. When wastewater is released into aquatic ecosystem, it can cause environmental problems. Biochar has received increased interest as a low-cost adsorbent. Biochar is a carbon-rich material that can be produced sludge by from organic materials. Here in Thailand, rice straw, coir and bagasse are agricultural wastes and locally available in large quantities. It was for this reason that the objective of this study was to investigate the effectiveness of biochars derived from rice straw, coir and bagasse to improve the quality of canteen wastewater.

Methods

Preparation and characterization of biochar.

The materials were sieved through a mesh of size 2mm and washed thoroughly. The raw materials were the placed inside muffle furnaces programmed to reach a final pyrolysis temperature of 300 ± 10 °C and then to maintain that temperature for a further 1 hour

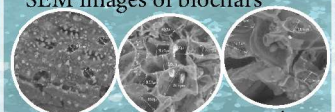
Absorption experiments

The effluent was diluted with distilled water at concentrations of 20%, 40%, 60%, 80% and 100%. 6 g of each biochar was added to 120 ml of each concentrations of wastewater. The parameters of wastewater were analyzed before and after treatment for all 3 types of biochars including, pH, biological oxygen demand (BOD), chemical oxygen demand (COD), total suspended solids (TSS), oil and grease, total phosphorus (TP) and total nitrogen (TKN) by standard methods.

Biochar characterization

Biochar	Yield (%)	Particle size			pH
		>2 mm	0.5-2 mm	< 0.5 mm	
Rice straw	39.5 ± 2.1	32.5 ± 1.6 %	54.1 ± 1.6 %	13.4 ± 0.3%	7.05 ± 0.22
Coir	38.6 ± 2.2	21.4 + 0.9 %	53.4 ± 1.9 %	25.2 ± 1.5 %	7.14 ± 0.15
Bagasse	32.7 ± 1.5	33.3 ± 2.3 %	52.6 ± 1.4 %	14.1 ± 1.1 %	7.21 ± 0.12

SEM images of biochars

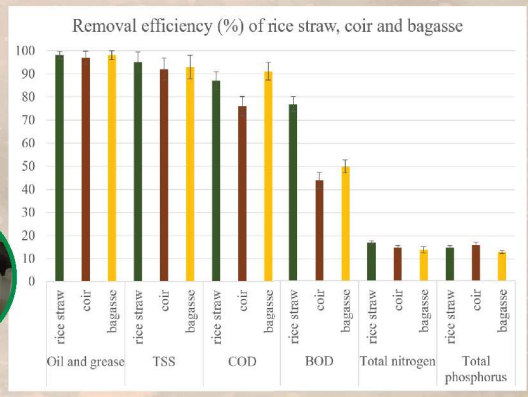


rice straw 5.94 µm | bagasse 11.7µm | coir 9.51µm

Results

Wastewater parameters before treatment and after treatment of wastewater concentration 20%

Parameters	Before treatment	After treatment		
		rice straw	coir	bagasse
pH	6.81 ± 0.14	6.98 ± 0.13	7.06 ± 0.17	7.07 ± 0.14
Oil and grease	95 mg/l	2 mg/l	2.5 mg/l	2.1 mg/l
Total suspended solid (TSS)	118 mg/l	5 mg/l	8.9 mg/l	8.1 mg/l
COD	1168 mg/l	142 mg/l	274 mg/l	102 mg/l
BOD	845 mg/l	190 mg/l	464 mg/l	422.5 mg/l



Conclusion

Biochar prepared from rice straw, coir and bagasse exhibited good adsorptive properties, and water quality after biochar treatment was improved. The removal efficiency of oil and grease, TSS, COD and BOD was high.
SEM images showed that the similar surface and pores of biochar resulted in a high degree of ion adsorption. It can be concluded that biochar derived from rice straw, coir and bagasse have the potential to be used as low-cost adsorbents for wastewater treatment.

Future Research

- To develope more suitable wastewater treatment system by using biochar.
- Compare between mix types of biochar and only 1 type for the best efficiency.
- We will develop into innovation for more benefit.

What We Learned

While preparing this project, We gained many scientific skills and learned co-opreation and teamwork. We knew how to make valuable of our time.

Acknowledgement

Department of Environmental Science, Faculty of Science, Chulalongkorn University

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